

3. Osphradium annular (0) or voluted (1).
4. Posterior caecum of stomach deep and bent laterally (0), or median and shallow (1), or altogether absent (2).
5. Typhosole **d** and the dorsal groove it defines absent (0) or present (1).
6. Opening of anterior digestive gland absent (0), anterior (1), posterior (2), or fused with that of posterior digestive gland (3).
7. Gastric shield small (0) or large (1).
8. Ovary lobes few and wide (0), or few globose (1), or several wide (2), or numerous digitiform (3).
9. Anterior end of ovary covering stomach (0) or posterior to it (1).
10. Posterior end of ovary reaching close to posterior end of body (0), or placed far from it (1).
11. Ovary entering ventral sperm canal (0) or posterior pallial oviduct (1).
12. Oviduct coiled (0), or just bent over itself (1).
13. Pallial oviduct divided into two (0) or three (1) distinct regions.
14. Albumen gland straight (0) or bent on itself (1).
15. Lobes of albumen gland small (0), or large and columnar (1).
16. Spermathecal duct absent (0) or present (1).
17. Spermathecal duct coalesced with (1) or independent of (2) oviduct.
18. Spermathecal duct long (1) or short (2).
19. Duct of seminal receptacle stemming off of oviduct (0), connected to it by a short sperm duct (1), or through a simple orifice where they are oppressed (3).
20. Uneverted penis straight (0) or coiled (1).
21. Terminal papilla on the verge simple (0) or eversible (1).
22. Surface of verge smooth (0), or creased and glandular (1).
23. Globose glands on convex side of verge absent (0) or present (1).
24. Stalked glands on convex side of verge absent (0), short (1), or cuplike (2).
25. Anterior concave side of verge with a non-glandular lobe (0), or with a lobe carrying discrete glands along its edge (1), or with a lobe of glandular tissue (2), or without such a lobe (3).
26. Subterminal ciliation on the verge present (0) or absent (1).
27. Longitudinal groove on verge absent (0) or present (1).

Six of the character-states used by Altaba are non-variable within the four cochliopine genera and have no comparative value except to separate the Cochliopinae from the Hydrobiinae. These are character-states 2, 5, 7, 11, 13, and 16.

Eight character-states also have little comparative value because of the manner in which the specimens were preserved and how these character-states were interpreted. For example, the head is illustrated as though it were in a natural relaxed condition (Altaba: 1993, fig. 3), yet if the specimens had been killed unrelaxed in formalin, the head and tentacles would have been severely contracted. Surely the head as illustrated is an interpretation and not an actual depiction. Interpretations of eight character-states used to separate *Antillobia* from *Heleobops* are questionable for the same reason. These include: (3) the

shape of the osphradium, (4) the size and shape of the posterior caecum of the stomach, (6) the opening of the digestive gland, (14) the shape of the albumen gland, (22) the texture of the penis surface, and (24) having unstalked or weakly stalked glands along the convex side of the penis. *Antillobia* is described as having discrete glands along the anterior concave side of verge (25). The depiction of these structures in Altaba: 1993, fig. 9 is non-convincing as glands and not as contracted folds of skin. *Antillobia* is said to have a longitudinal groove on [the dorsal surface of] the penis (27). This also is an artifact of preservation due to intense contraction and partial desiccation of the animals caused by having been killed and fixed in formalin.

Five character-states pair *Antillobia* with *Heleobops*, and separate the two from *Spurwinkia* and *Heleobia*. These are: the ciliation pattern on the tentacles (1-1), the anterior extent of the ovary over the stomach (9-1), the weak coiling of the oviduct (12-1), the short spermathecal duct (19-2), and the presence of globose glands along the convex side of the verge (23-1).

Five-character states group *Antillobia* and *Heleobops* with *Heleobia*, and separate the three from *Spurwinkia*. These are: the independent spermathecal duct from the oviduct (17-2), the short spermathecal duct (18-2), the coiled uneverted penis (20-1), the simple terminal papilla on the verge (21-0), and the absence of subterminal ciliation on the verge (26-1).

Three character-states are left to separate *Antillobia* from *Heleobops*. These are (8) the size and number of the ovary lobes, (10) the location of the ovary within the digestive gland, and (15) the size and shape of the albumen gland lobes. These three characters hardly constitute a basis for separating genera, especially considering that the data are based only on two inadequately preserved specimens.

Two taxonomic questions are posed by the description of *Antillobia margalefi*. One question is the status of the genus name *Antillobia*, and the other question is the status of the species name *margalefi*. The description and illustrations given for *Antillobia* pertain to two previously known species, *Pyrgophorus coronatus bermudezi* (Aguayo, 1947) and *Heleobops clytus* Thompson & Hershler, 1991. Both are common species about Lago de Enriquillo, and they are the only two hydrobiids known to occur there. *Heleobops clytus* is oviparous with the uterus unmodified into a brood pouch, and the verge (penis) bears unstalked apocrine glands along its outer curvature. *Pyrgophorus coronatus bermudezi* is viviparous, with a brood-pouch containing developing juveniles, and the verge bears elongate papillae along the outer curvature and elsewhere, as is typical for *Pyrgophorus* (Hershler & Thompson, 1992:90-91). The female reproductive anatomy of *Antillobia*, as described and figured by Altaba, lacks a brood pouch with developing embryos and juveniles (Altaba, 1993, fig. 4), as is typical for *Heleobops*.

The penis, as described by Altaba, has unstalked apocrine glands along its outer curvature. The anatomical data presented by Altaba for *Antillobia* pertains to *Heleobops*.

Under normal circumstances, the anatomical information would resolve the identity of *A. margalefi*, but shell features add confusion. The designated holotype is a "large" intact specimen in alcohol (approx. 2.4 mm long and consisting of five whorls). Shells of *H. clytus* and *P. c. bermudezi* are very similar to each other, and sometimes it is not possible to separate the shells of immature specimens (see Thompson & Hershler, 1991:674). The shell length and number of whorls of the holotype suggest a juvenile male of either species. Both species are sexually dimorphic in size, with females being much larger than males with the same number of whorls. Females 2.4 mm in length of either species typically have four or fewer whorls. The description of the shell seems to be a composite of characters from two species. *Antillobia margalefi* is described as having slightly swollen whorls with a moderately deep suture. *The periostracum is pale ochre in color* and has numerous exceedingly faint, thin, irregularly spaced spiral striations. *The peristome is continuous across the parietal margin*. The traits in italics are typical for *P. c. bermudezi*. The other traits are typical for *H. clytus*. The figure of the holotype of *A. margalefi* (Altaba, 1993, fig. 1) is most similar in appearance to typical male *P. c. bermudezi*. However, the specific identity cannot be resolved unless the holotype is dissected, which undoubtedly would require destroying the shell. Under the circumstances, the name *Antillobia margalefi* must be considered a synonym of *Pyrgophorus coronatus bermudezi* because of the holotype shell, even though the anatomical data given by Altaba pertain to *Heleobops clytus*.

The following taxonomic changes are in order.

(1) The species name *Antillobia margalefi* Altaba, 1993, is a subjective junior synonym of *Pyrgophorus coronatus bermudezi* (= *Lyrodes coronatus bermudezi* Aguayo, 1947).

(2) The genus name *Antillobia* Altaba, 1993, is a subjective junior synonym of *Pyrgophorus* Ancy, 1888, because its type species is a *Pyrgophorus*.

(3) The anatomical data presented by Altaba, which pertain to *Heleobops clytus*, do not justify separation of *Heleobops clytus* Thompson & Hershler, 1991, as a genus distinct from *Heleobops docimus* Thompson, 1968, the type species of *Heleobops*. Synonymies for the two species are as follow.

Pyrgophorus coronatus bermudezi (Aguayo, 1947)

Lyrodes coronatus bermudezi Aguayo, 1947:81–83; fig. 1 (holotype), fig. 2 (paratypes).

Pyrgophorus coronatus bermudezi (Aguayo), Thompson & Hershler, 1991: 679; fig. 4. Hershler & Thompson, 1992:92.

Antillobia margalefi Altaba, 1993: 73, 90; fig. 1.

Type locality: *Lyrodes coronatus bermudezi*: República Dominicana, Provincia de Barahona, Lago Enriquillo, cerca de Mella (now in Provincia Independencia), Pleistoceno (?). Holotype: Museo Poey, no. 12146. *Antillobia margalefi*: Lago Enriquillo (*sic*), Dominican Republic. Holotype: Museu de la Naturalesa de les Illes Balears, Ciutat de Mallorca, uncatalogued.

Distribution: Known only from the vicinity of Lago de Enriquillo. Other forms of *Pyrgophorus coronatus* are found elsewhere on Hispaniola.

Specimens examined: DOMINICAN REPUBLIC. *Independencia Prov.*: spring 2 km ESE of Duverge (UF 175165); spring, 6 km WNW of Duverge (UF 174885, preserved UF 252046); spring, Boca de Cachón (UF 175215); spring, 4 km E of La Descubierta (preserved UF 252048); spring, 1 km W of Las Baitoas (UF 174889).

Heleobops docimus Thompson & Hershler, 1991

Heleobops clytus Thompson & Hershler, 1991: 672–674; fig. 3. Hershler & Thompson, 1992: Malacological Review, Suppl. 5:60; figs. 34, 35a.

Antillobia margalefi (in part) Altaba, 1993: 73, 90; figs. 3–10.

Type locality: A spring 2 km ESE of Duverge, Independencia Prov., Dominican Republic. Holotype: UF 175170.

Distribution: At present known only from the environs of Lago de Enriquillo and the Laguna del Rincón, Dominican Republic. All of these stations are in the *cul de sac* that extends from Barahona, Dominican Republic to Port-au-Prince, Haiti. *Heleobops* is widespread elsewhere on Hispaniola, but the taxonomy of these other populations has not been resolved yet.

Specimens examined: HISPANIOLA. DOMINICAN REPUBLIC. *Independencia Prov.*: spring 2 km ESE of Duverge (holotype, paratypes UF 135428, 174880, preserved UF 93973); Laguna Del Rincon, 6 km. WNW Cabral (UF 175203, UF 174884, preserved UF 93976); spring 5 km WNW Duverge (UF 174881, UF 175202); spring, Boca de Cachón (UF 174891, preserved UF 93974); spring 1 km W of Las Baitoas (UF 174887, preserved UF 175199); spring along N shore Lago de Enriquillo, 4 km E La Descubierta (UF 174894, preserved UF 175201); Laguna La Sequia, 1 km S of Augustura (UF 45687); spring, 4 km ENE Neiba (UF 174896, preserved UF 175200).

Lago de Enriquillo is fed by seasonal rivers and by numerous springs along the south, west, and north shores. The two hydrobiid species are abundant on vegetation in springs and spring-fed streams that drain into the lake. The more saline environ of the lake is nearly devoid of aquatic angiosperms, and snails are very sparse or absent there.

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Predation of Water Bug *Sphaerodema rusticum* on the Freshwater Snails *Lymnaea (Radix) luteola* and *Physa acuta*

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The freshwater snails *Lymnaea (Radix) luteola* Lamarck, 1822, and *Physa acuta* Draparnaud, 1805, are found side by side in nature where they are occurring. It is practically impossible to distinguish them at a glance. The water bug *Sphaerodema rusticum* Fabr. preys upon both the snail species (Raut et al., 1988; Aditya & Raut, in press). Since the prey individuals are of similar type with respect to their shell contour and size, the aim of this study was to determine whether the water bug *Sphaerodema rusticum* has preference for either of the species and, if so, whether the water bug is able to select the individuals belonging to the preferred prey species when both the prey species are found together. The snail *L. (R.) luteola* is involved in the spread of worm diseases in man and animals (Raut, 1986, 1991; Subba Rao, 1989; Mukhopadhyay, 1991; Srivastava, 1991; Subba Rao & Mitra, 1991), and *P. acuta* is causing serious problems in sewage purification plants (Macha, 1971). Attempts are being made to control these snails through the use of biological agents. Therefore, the findings of the present study will enable us to gain some knowledge on the effective use of the water bug *S. rusticum* to control the snails *L. (R.) luteola* and *P. acuta*.

Materials and Methods

A large number of *L. (R.) luteola* and *P. acuta* 6-7 mm in shell length were collected from the municipality

drains in Kolkata, India. The adult morphs of the water bug *S. rusticum* were also collected from the same drain simultaneously. They were kept in the laboratory in pond water, in plastic containers. The snails were fed with lettuce regularly for a period of 7 days. The water bugs were allowed to feed on the snails kept in the containers. After 1 week, the following experiments were performed to note the rate of predation of *S. rusticum* on the prey individuals supplied.

- Experiment I. 40 *L. (R.) luteola* were exposed to an adult *S. rusticum*.
- Experiment II. 40 *P. acuta* were exposed to an adult *S. rusticum*.
- Experiment III. 40 prey individuals (20 *L. (R.) luteola* and 20 *P. acuta*) were exposed to an adult *S. rusticum*.

The same-sized *L. (R.) luteola* and *P. acuta* were almost equal in weight.

Experiments were carried out in plastic containers, each 25 cm in diameter and 8 cm in depth, containing 2.5 L pond water. All the experiments were carried out for 7 consecutive days. Experiments with the single prey species were repeated three times, while those with the combination of two prey species were repeated six times. Data were collected on the number of snails consumed completely (except the shell) and partially, at the end of each 24 hour period. The water in the container was replaced by fresh pond water, and the prey snail individuals, as per specification were released into the container every 24 hours. In all cases, mean and standard error ($\pm$ SE) were calculated. Analysis of variance (ANOVA) was applied (Campbell, 1989) to ascertain whether the rate of predation differed significantly with the prey species, singly, or in combinations of the two, or not.

Results

Experiment I

In 21 trials the adult *S. rusticum* killed a total of 262 *L. (R.) luteola*. Of these, 179 (68.32%) and 83 (31.68%) were devoured completely and partially, respectively, by the water bug. The water bug killed 8-18 (average 12.48 ± 0.65) individuals per day. The number of completely and partially consumed individuals ranged from 6-10 (average 8.52 ± 0.31) and 0-9 (average 3.96 ± 0.51) per day (Figure 1), respectively.

Experiment II

The water bug killed a total of 217 *P. acuta* in 21 trials in 7 days. The number of completely and partially devoured individuals was 82 (37.79%) and 135 (62.21%), respectively. The daily rate of predation ranged from 7-16 (average 10.33 ± 0.56). Of these, 0-10 (average 3.9 ± 0.45) and 2-14 (average 6.43 ± 0.7) individuals were